

PORTABLE DEVICE AND METHOD OF PROVIDING USER WITH INFORMATION ON OPERATION OF PORTABLE DEVICE

FIELD

- 5 **[0001]** The invention relates to a portable device. A portable device refers to mobile station, for example, or to some other subscriber terminal of a telecommunication system. Furthermore, the invention relates to a method of providing a user with information on the operation of the portable device.

BACKGROUND

- 10 **[0002]** A portable device provides a user with information on its operation by using a tone. A tone refers herein to various tone signals. The structure of a tone can be relatively complicated: it can, for example, be a short tune, which consists of notes and is used in a mobile station to indicate an incoming call.

- 15 **[0003]** In psychoacoustics, a phenomenon called masking effect is known, which means that if two sounds are close enough to each other both in time and in regard to frequency, the louder sound masks out the quieter one. In a typical usage environment of a portable device there is nowadays quite much different background noise, which is caused for example by various devices and machines, such as different vehicles, and by activities of people.
- 20 Background noise can thus mask out the tone of a device, and the user of the device does not hear an event relating to the operation of the device, such as an incoming call.

- 25 **[0004]** A prior art solution to this problem is a manual volume control in a portable device. The problem is, however, that volume must always be adjusted manually suitable according to background noise of each usage environment. In addition, when background noise is loud enough, the volume control does not necessarily help. Another solution is to give information in a manner that can be perceived by other senses, such as senses of touch or sight. The problem in these solutions is that they require that the device is either held against the skin or in such a place where it can be seen. Further-
- 30 more, additional devices, such as a vibrating alarm or a signal light, cause additional manufacturing costs for the device.

BRIEF DESCRIPTION

[0005] The object of the invention is to provide an improved portable device and an improved method of providing a user with information on the operation of the portable device. Portable devices according to claims 1 and 17 are set forth as aspects of the invention. Furthermore, methods of providing a user with information on the operation of the portable device, as claimed in claims 20 and 34, are set forth as aspects of the invention. The preferred embodiments of the invention are disclosed in the dependent claims.

[0006] The invention is based on producing a tone which, due to a tone feature, can be distinguished from background noise. This feature can be tone frequency, duration, volume or time. The device can analyse background noise automatically, and based on this, it adjusts at least one feature of the tone automatically such that the tone can be distinguished from background noise and the background noise does not mask out the tone. Alternatively, the user himself can adjust the tone frequency or duration in a desired way so that it would be distinguished from background noise more clearly.

LIST OF FIGURES

[0007] The preferred embodiments of the invention are described here by way of example with reference to the attached drawings, wherein

20 [0008] Figure 1 is a simplified block diagram illustrating an example of the structure of a portable device:

[0009] Figures 2 and 3 are flow charts illustrating methods of providing a user with information on the operation of the portable device.

DESCRIPTION OF EMBODIMENTS

25 **[0010]** With reference to Figure 1, an example of the structure of a
typical portable device will be described in the following. It concerns a mobile
telephone but it is obvious that the invention is not restricted thereto, but also
other portable devices, such as various terminals of telecommunication sys-
tems, are portable devices in accordance with the invention. One sub-group of
30 these terminals include terminals in mobile systems based on a wireless radio
connection, i. e. mobile stations.

[0011] A mobile station comprises control means 106 for monitoring and controlling the operation of the device and for implementing various functions defined for the device. Typically, the control means 106 are implemented

ceeded. The feedback comprises an incoming-call alarm. Different callers and/or caller groups can be indicated by different alarm tones. The above-described examples of the abstract information to be conveyed as tone to the user on the operation of the portable device are only a minor part of all potential information that could be conveyed to the user by means of the invention.

[0016] The control means 106 are thus arranged to give the user feedback on the operation of the device by using tone that is produced by the tone means 114. The portable device further comprises determining means 106, 112 for determining the volume of background noise of the environment where the device is used. On the basis of background noise volume, the control means 106 are arranged to automatically adjust at least one tone feature that can be sensed by hearing, such that the tone can be distinguished from background noise by human hearing sense.

[0017] The determining means 106, 112 comprise conversion means 112 for performing an acousto-electric conversion for background noise and the control means 106, which are arranged to determine the volume of background noise by analysing an electric signal representing background noise. At their simplest, the conversion means 112 are implemented as a microphone of the device. The electric signal from the microphone 112 is then analysed by software implemented in the microprocessor 106, which software can in the most complicated case be a frequency analyzer, by which the volume of background noise in different frequency ranges can be analysed.

[0018] In a preferred embodiment, the tone feature to be adjusted is tone frequency. The tone frequency is adjusted such that masking effect can be diminished.

[0019] In a preferred embodiment, the control means 106 are arranged to produce a tone particularly at such frequencies where the volume of background noise is low. For instance, if background noise is loud in a low-frequency range, the tone signal of the device is implemented in a high-frequency range, and the masking effect caused by background noise does not mask out the tone signal of the device.

[0020] In a preferred embodiment, the tone feature to be adjusted is tone volume. The tone volume is adjusted such that the masking effect can be diminished.

[0021] In a preferred embodiment, the control means 106 are arranged to produce a tone that is louder than background noise.

[0022] In a preferred embodiment, the tone feature to be adjusted is the moment of time at which the tone is produced. This moment of time is adjusted so that the masking effect can be diminished.

[0023] In a preferred embodiment, the determining means 106, 112 are arranged to determine the moment at which a sudden background noise of short duration occurs, and the control means 106 are arranged to produce a tone nonsimultaneously with the moment at which background noise occurs, i.e. at least partly before or after that moment. If background noise is, for example, a hammerblow, the device delays the tone production for example by 200 milliseconds and the tone does not fade under background noise. If background noise is to some extent regular, for example regularly occurring hammerblows, this can be analysed and the tone can be produced at such moments when there is no noise.

[0024] In a preferred embodiment, the tone feature to be adjusted is tone duration. The tone duration refers herein to the length of a tone signal, an individual note or of an entire tune. The tone duration is adjusted such that the masking effect can be diminished.

[0025] In a preferred embodiment, the control means 106 are arranged to form a tone from notes and to make the individual notes sound longer when background noise is getting louder. According to the tests carried out by the applicant, tunes that are composed of individual notes that are made to sound longer are perceived more easily in noisy surroundings than notes of normal length.

[0026] In a preferred embodiment, the control means 106 are arranged to receive a control relating to at least one of the tone features that can be sensed by hearing and controlling the tone production carried out by the user interface 118 of the portable device. This means that although the device adjusts some tone feature(s) automatically, it is the user who sets such limits to the adjustment that cannot be exceeded.

[0027] In a preferred embodiment, tone frequency ranges that can be selected automatically by the control means 106 are selected by the control. For example, older people do not usually hear higher frequency ranges of tones, in which case the control can prevent the device from trying to diminish the masking effect caused by low-frequency background noise by transposing the tone to a high frequency, which the user cannot hear any way. A person may also have a hearing defect, which is present in a certain frequency range.

In such a case, he should be able to set that kind of settings to the device that the tones are not automatically transposed to that particular frequency range. The frequency ranges can be selected relatively roughly, for example high/middle/low, or, if desired, by a more exact grouping, for example at intervals of 1000 to 5000 herz.

[0028] In a preferred embodiment, tone durations that can be selected automatically by the control means 106 are selected by the control. With this choice the user can change the permanent settings according to his wishes and adjust the rhythm of the ringing tone in a way.

[0029] So far, a portable device has been described, which comprises determining means for determining the volume of background noise, and, on the basis of the background noise volume, adjusting some tone feature to diminish the masking effect. In the following, a device is described, which does not comprise determining means but which can, however, also diminish the masking effect. The determining means are in a way replaced by the measures taken by the user himself. Such a portable device comprises control means 106 for controlling the operation of the device, a user interface 118 in connection with the control means 106, and tone means 114 that are controlled by the control means 106 and that produce sound electroacoustically. The control means 106 are arranged to give feedback on the operation of the device by using the tone produced by the tone means 114. Unlike the above described device, the control means 106 are arranged to receive a control affecting the tone frequency and/or duration and controlling the tone production carried out by the user interface 118, and to adjust the tone frequency and/or duration according to the control. Thus, if the user detects that he does not hear the tone of his device, for instance due to low-frequency background noise, he adjusts his device via the user interface 118 to use high-frequency tones. Correspondingly, the user can adjust the notes to sound longer in noisy surroundings.

[0030] Figure 2 illustrates a method of providing a user with information on the operation of the portable device. The performance of the method starts from block 200, i.e. in practice at the moment the user of the device switches on the device. In block 202, an event that interests the user and concerns the operation of the device is detected.

[0031] In block 204, the volume of background noise in the usage environment of the device is determined.

the device controls some tone feature automatically on the basis of the analysis carried out by the determining means.

- 5 **[0036]** Even though the invention is described above with reference to the example of the attached drawings, it is obvious that the invention is not restricted thereto but it can be modified in a variety of ways within the inventive idea disclosed in the accompanying claims.

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